Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

Centre Number | Candidate Number

Wednesday 10 June 2020

Morning (Time: 1 hour 45 minutes) | Paper Reference **1CH0/2H**

Chemistry

Paper 2

Higher Tier

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.
- A periodic table is printed on the back cover of this paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) A chloride ion, a fluorine atom and a nanoparticle are all types of particle.

Which of the following shows the particles in order of size, starting from the smallest?

(1)

☐ **A** nanoparticle, fluorine atom, chloride ion

☐ **B** nanoparticle, chloride ion, fluorine atom

☐ **C** fluorine atom, nanoparticle, chloride ion

☐ **D** fluorine atom, chloride ion, nanoparticle

(b) A solution, **X**, is thought to contain chloride, bromide or iodide ions.

(i) The solution is tested to see whether it contains one of these ions.
In the test, a few drops of **two** different solutions are added to **X**.

Name the two solutions that are added in the test.

(2)

solution 1 ....

solution 2 ....

(ii) The student carrying out the test records the following result.

> A precipitate forms in the test tube. The precipitate is a cream/yellow colour.

Explain why the anion in **X** cannot be known for certain.

(2)

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(iii) The metal ions in **X** could be identified using a flame test.
There is a more sensitive and accurate instrumental method that can be used.

Give the name of an instrument that can be used to identify the metal ions in **X**.

(1)

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(Total for Question 1 = 6 marks)

2 (a) An atom of potassium has atomic number 19 and mass number 39.

(i) Give the electronic configuration of this potassium atom.

(1)

....

(ii) This potassium atom forms the ion K^+.

Which row shows the number of protons and the number of neutrons in this potassium ion, K^+?

(1)

		number of protons	number of neutrons
☒	**A**	19	19
☒	**B**	19	20
☒	**C**	20	19
☒	**D**	20	20

(b) Potassium and caesium are in the same group of the periodic table.

Explain, in terms of electrons, why potassium and caesium are in the same group.

(2)

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(c) Fluorine boils at −188 °C.
There are forces between fluorine molecules.

Explain, in terms of these forces, why the boiling point of fluorine is low.

(2)

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(d) Potassium reacts with fluorine to form potassium fluoride.
Potassium fluoride is a solid.

Complete the balanced equation for this reaction and add the state symbols.

(3)

..................K (...........) + F_2(g) → ....KF (...........)

(Total for Question 2 = 9 marks)

3 Calcium carbonate reacts with dilute hydrochloric acid to produce carbon dioxide gas.

The rate of reaction between calcium carbonate and dilute hydrochloric acid at room temperature was investigated.

(a) The investigation was carried out with different sized calcium carbonate pieces.

The mass of calcium carbonate and all other conditions were kept the same.

The results are shown in Figure 1.

size of calcium carbonate pieces used	volume of carbon dioxide gas produced in five minutes in cm^3
large	16
small	48
powder	90

Figure 1

State, using the information in Figure 1, the effect of the surface area of the calcium carbonate on the rate of this reaction.

(1)

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(b) The calcium carbonate powder produced 90 cm^3 of carbon dioxide in five minutes.

Calculate the average rate of reaction in $cm^3\ s^{-1}$.

(3)

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average rate of reaction = ... $cm^3\ s^{-1}$

(c) The experiments were repeated at a higher temperature.
The rate of reaction for each experiment increased.

Explain, in terms of particles, why the rate of reaction increased when the temperature was increased.

(3)

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(Total for Question 3 = 7 marks)

4 Figure 2 shows the structure of a molecule of dichloroethene.

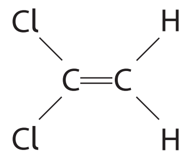

Figure 2

(a) (i) Describe how dichloroethene monomers form a polymer.

(2)

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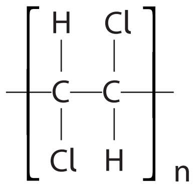
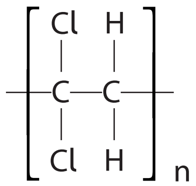
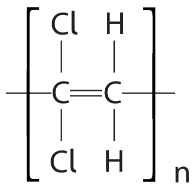
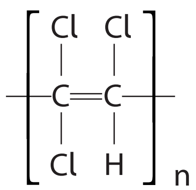
(ii) Which of these represents the structure of the polymer formed from the monomer in Figure 2?

(1)

☒ **A** 

☒ **B** 

☒ **C** 

☒ **D** 

(iii) Separate samples of dichloroethene and poly(dichloroethene) are shaken with a few drops of bromine water.

What would be **seen**?

(1)

- ☒ **A** both mixtures remain orange
- ☒ **B** only the dichloroethene and bromine water goes colourless
- ☒ **C** only the poly(dichloroethene) and bromine water goes colourless
- ☒ **D** both mixtures go colourless

(b) Dichloroethene is produced from ethene and chlorine.

In the overall reaction, ethene reacts with chlorine and forms dichloroethene and hydrogen chloride.

Complete the balanced equation for the overall reaction.

(2)

$$C_2H_4 + 2Cl_2 \rightarrow C_2H_2Cl_2 + \ldots\ldots$$

(c) Poly(dichloroethene) was used to wrap food to keep it fresh.

Explain **one** property that a plastic food wrapping must have.

(2)

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(d) An industrial process uses 500 tonnes of dichloroethene.
In the process only 96.5% of the dichloroethene molecules react.

Calculate the mass of dichloroethene that has **not** reacted.

Give your answer to two significant figures.

(3)

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mass = ... tonnes

(Total for Question 4 = 11 marks)

5 (a) Figure 3 shows the structure of two monomers.

monomer A	monomer B
HO—CH_2—CH_2—OH	HOOC—CH_2—CH_2—COOH

Figure 3

(i) Monomer **B** contains a carboxylic acid group.

Describe what you would **see** when a small amount of solid sodium carbonate is added to a solution of monomer **B**.

(2)

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....

....

(ii) When monomer **A** and monomer **B** react together they polymerise to form a polymer and one other product.

Name the type of polymerisation that takes place and name the other product.

(2)

type of polymerisation ....

name of other product ....

(iii) A naturally occurring polymer is made by combining monomers called nucleotides.

Give the name of this natural polymer.

(1)

....

(b) Some polymerisation reactions produce ammonia as a waste product.

A student is given a sample of pure, dry ammonia gas.

The student suggests the following method to test for ammonia gas.

step 1 take some dry, blue litmus paper

step 2 place the dry litmus paper into the dry gas

step 3 observe any change in colour of the litmus paper

This test for ammonia will not work.

Give **two** changes that should be made to this test for it to work.

(2)

change 1 ....

....

change 2 ....

....

(c) Alcohols can be dehydrated.

Complete the balanced equation for the dehydration of butan-1-ol by drawing the structures of the two products in the boxes. Name the two products.

(3)

$CH_3—CH_2—CH_2—CH_2—OH \rightarrow$ [ ] + [ ]

butan-1-ol $\rightarrow$ .... + ...

(Total for Question 5 = 10 marks)

6 (a) Sodium thiosulfate solution, $Na_2S_2O_3$, reacts with dilute hydrochloric acid.

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

(i) When dilute hydrochloric acid is mixed with sodium thiosulfate solution, the mixture turns cloudy.

Explain why the mixture turns cloudy.

(2)

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(ii) In an investigation, different concentrations of hydrochloric acid are reacted with sodium thiosulfate solution.
The mixture goes cloudy at different rates.

Describe how the rate at which the mixture goes cloudy can be measured.

(3)

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(iii) You are provided with some dilute hydrochloric acid which has a concentration of $50\,g\,dm^{-3}$.

For this experiment, dilute hydrochloric acid with a concentration of $20\,g\,dm^{-3}$ is required.

How much water must be added to $100\,cm^3$ of $50\,g\,dm^{-3}$ hydrochloric acid to make dilute hydrochloric acid with a concentration of $20\,g\,dm^{-3}$?

(1)

☒ **A** $200\,cm^3$

☒ **B** $150\,cm^3$

☒ **C** $100\,cm^3$

☒ **D** $50\,cm^3$

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b) Sodium iodide solution is colourless.

When a solution of bromine is added to sodium iodide solution, a reaction occurs.

$$2NaI + Br_2 \rightarrow 2NaBr + I_2$$

(i) The mixture turns brown.

Give the name of the substance causing the brown colour.

(1)

....

(ii) Explain which substance has been reduced in this reaction.

(2)

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(Total for Question 6 = 9 marks)

7 (a) Air contains several gaseous elements.

Which of these shows the three most common gaseous elements in air, listed in order from the most common to the least common?

(1)

☒ **A** oxygen, chlorine, nitrogen

☒ **B** nitrogen, oxygen, hydrogen

☒ **C** oxygen, nitrogen, helium

☒ **D** nitrogen, oxygen, argon

(b) The density of a gas can be found using the equation

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

A student carried out an experiment to find the density of argon.

The mass of a stopper and flask, containing no gas, was known.
The flask was completely filled with argon and its mass measured.

Figure 4 shows the results the student wrote down.

mass of stopper and flask in g	78.639
mass of stopper and flask full of argon in g	79.120
volume of flask in cm^3	250.0

Figure 4

(i) Use the results to calculate the density of argon in $g\,cm^{-3}$.

(2)

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....

density of argon = ... $g\,cm^{-3}$

(ii) The flask used for the experiment is shown in Figure 5.
The flask holds 250.0 cm^3 when filled up to the line.

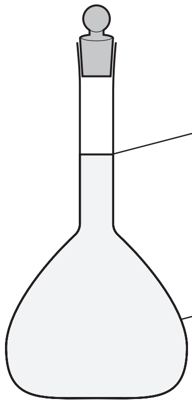

Figure 5

There is an error in the volume the student has used in the calculation.
This would give an incorrect value for the density of argon.

Identify this error and state what should be done to correct it.

(2)

error ....

....

what should be done to correct it ....

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....

(c) Four of the noble gases are argon, helium, krypton and neon.

Give these gases in order of increasing density.

(2)

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(d) Much of the carbon dioxide present in the Earth's early atmosphere dissolved into the oceans.

This led to the formation of compounds including calcium carbonate, $CaCO_3$.

Some of the calcium carbonate reacted with magnesium ions to form dolomite, $CaMg(CO_3)_2$.

Complete the **ionic** equation for the reaction of calcium carbonate with magnesium ions.

(2)

$$\ldots\ldots CaCO_3 + \ldots\ldots \rightarrow CaMg(CO_3)_2 + Ca^{2+}$$

dolomite

(e) **P** and **Q** are both mixtures of gases.
One has the same composition as the early atmosphere and the other has the same composition as the current atmosphere.

Tests are carried out on gas mixtures **P** and **Q**.

The test for carbon dioxide is to bubble the gas into limewater; if carbon dioxide is present calcium carbonate is formed.

The results of the tests are shown in Figure 6.

test	result with gas mixture P	result with gas mixture Q
bubble gas into limewater	white precipitate forms after 4 minutes	white precipitate forms after 10 seconds
place burning splint into gas mixture	splint continues to burn	splint immediately goes out

Figure 6

Explain, using the data in Figure 6, which gas mixture represents the early atmosphere.

(2)

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(Total for Question 7 = 11 marks)

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8 The first four elements in group 1 are lithium, sodium, potassium and rubidium.

(a) Rubidium reacts with water to form rubidium hydroxide and hydrogen.

$$2Rb(s) + 2H_2O(l) \rightarrow 2RbOH(aq) + H_2(g)$$

(i) Predict what you would **see** when a small piece of rubidium is placed in a large volume of water.

(3)

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(ii) Why is rubidium more reactive than potassium?

(1)

☒ **A** the metallic bonds in rubidium are weaker than those in potassium

☒ **B** rubidium is a softer metal than potassium

☒ **C** the outer electron of a rubidium atom is further from the nucleus than potassium's

☒ **D** rubidium has a more exothermic reaction with water than potassium does

(iii) 8.5 g of rubidium are reacted completely with water.

The reaction makes a solution of rubidium hydroxide.
The volume of this solution is 2.5 dm^3.

Calculate the concentration of the rubidium hydroxide solution in g dm^{-3}.

(relative atomic mass: Rb = 85; relative formula mass: RbOH = 102)

(4)

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concentration = ... g dm^{-3}

(b) An example of an endothermic reaction is the reaction between rubidium hydroxide and ammonium carbonate, $(NH_4)_2CO_3$.

This reaction forms rubidium carbonate, Rb_2CO_3, ammonia and one other product.

Write the balanced equation for this reaction.

(3)

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(Total for Question 8 = 11 marks)

9 (a) An impure hydrocarbon fuel is burned in the apparatus in Figure 7.

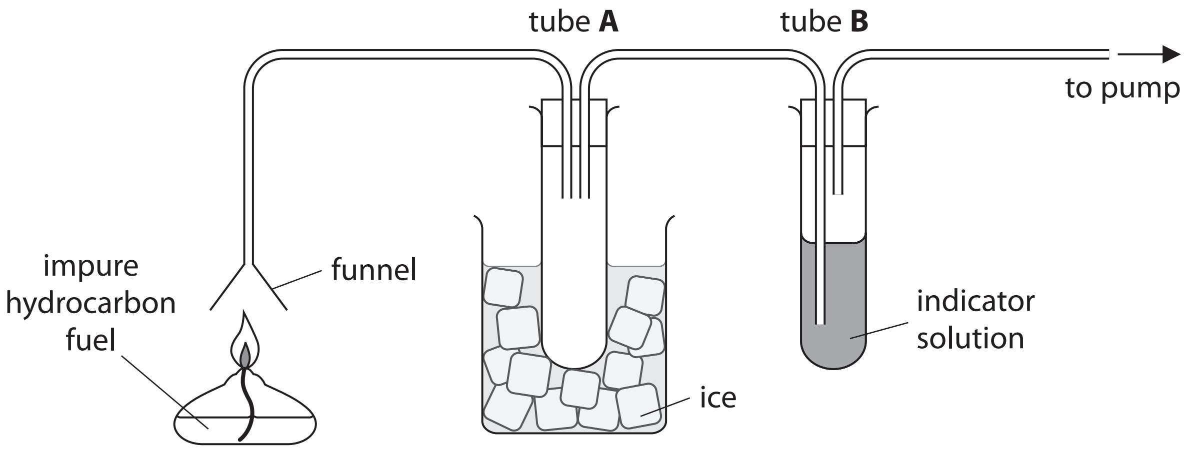


Figure 7

When the fuel is burned

- the funnel becomes hot
- a colourless liquid forms in tube **A**
- the indicator in tube **B** changes colour to show an acidic gas.

Explain these observations.

(3)

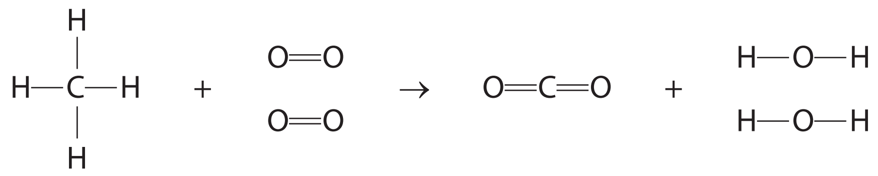
(b) The energies of some bonds are shown in Figure 8.

bond	**bond energy in kJ mol^{-1}**
C—H	435
O═O	496
C═O	805
H—O	463

Figure 8

Methane burns in oxygen to form carbon dioxide and water.

The equation shows the structures of the molecules.



Calculate the energy change, in kJ mol^{-1}, for this reaction.

(4)

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energy change = ... kJ mol^{-1}

*(c) Petrol and diesel are used as fuels for cars.
The emissions from three similar sized cars were investigated.
The first car was the oldest, had no catalytic converter and used petrol.
The other two cars were only a few years old.
One of these was fitted with a catalytic converter and used petrol and the other car used diesel.

Figure 9 shows the emissions in grams for each kilometre travelled by these three cars.

	emissions in g km^{-1}			
	carbon monoxide	**nitrogen oxides**	**carbon dioxide**	**carbon particulates**
car with no catalytic converter using petrol	1.60	0.09	180	0.00
car with catalytic converter using petrol	0.67	0.02	180	0.00
car using diesel	0.05	0.19	130	0.02

Figure 9

Discuss and compare the impact on the environment of the emissions from these three cars using the information from Figure 9.

(6)

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(Total for Question 9 = 13 marks)

10 (a) Figure 10 shows a flask fitted with a cotton wool plug.
The flask contains an aqueous solution of a carbohydrate.

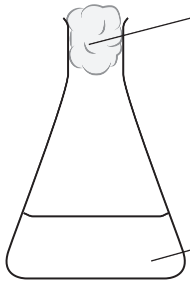

Figure 10

(i) State **two** steps that need to be taken to turn the solution of the carbohydrate in the flask into a solution of ethanol.

(2)

1 ....

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2 ....

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(ii) The apparatus in Figure 11 is used to increase the concentration of the dilute solution of ethanol.

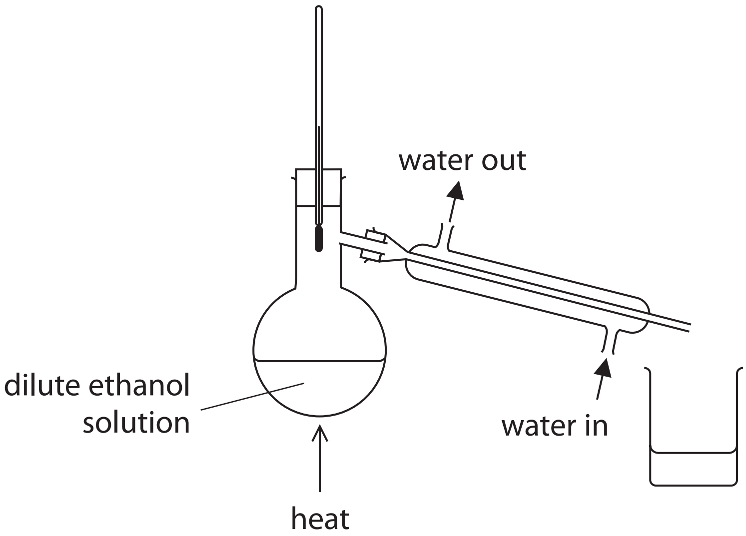

Figure 11

This apparatus did not produce a very concentrated solution of ethanol.

Describe how the apparatus can be altered to produce a more concentrated solution of ethanol.

(2)

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(b) The equation for the fermentation of a carbohydrate is

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

Calculate the maximum mass of carbon dioxide that could be produced if 135 g of this carbohydrate is fully fermented.

(relative formula masses: CO_2 = 44; $C_6H_{12}O_6$ = 180)

(3)

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mass of carbon dioxide = ... g *(c) Figure 12 shows information about some compounds in the same homologous series.

name	structural formula	formula mass	density in g cm^{-3}	boiling point in °C	does it react with an alcohol?	does it react with sodium hydroxide solution?
butanoic acid	$CH_3CH_2CH_2COOH$	88	0.96	164	yes	yes
ethanoic acid	CH_3COOH	60	1.05	118	yes	yes
hexanoic acid	$CH_3CH_2CH_2CH_2CH_2COOH$	116	0.93	205	yes	yes
pentanoic acid	$CH_3CH_2CH_2CH_2COOH$	102	0.94	186	yes	yes
propanoic acid	CH_3CH_2COOH	74	0.99	141	yes	yes

Figure 12

Explain, using the data in Figure 12, why these compounds belong together in the same homologous series.

(6)

(Total for Question 10 = 13 marks)

TOTAL FOR PAPER = 100 MARKS

The periodic table of the elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86

***** *The elements with atomic numbers from 58 to 71 are omitted from this part of the periodic table.*

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.